POLARIMETRIC MEASUREMENTS OF SEA SURFACE BRIGHTNESS TEMPERATURES USING AN AIRCRAFT K-BAND RADIOMETER

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This paper presents the first experimental evidence that the polarimetric brightness temperatures of sea surfaces are sensitive to ocean wind direction in the incidence angle range of 30 to 50 degrees. our experimental data were collected by a K-band (19.35 GHz) polarimetric radiometer (WINDRAD) mounted on the NASA DC-8 aircraft, A set of aircraft radiometer flights was successfully completed in November 1993. We performed circle flights over NDBC moored buoys deployed off the northern California coast, which provided ocean wind measurements. The first WINDRAD flight was made on November 4, 1993. There was clear weather with a wind speed of 12 m/s at 330 degrees around the Pt. Arena buoy. We circled the buoy at three incidence angles, and all data when plotted as functions of azimuth angles snow clear modulations of several degrees Kelvin. At 40 degrees incidence angle, there was a 5 degrees Kelvin peak-to-peak signal in the second Stokes parameter Q and the third Stokes parameter U. The Q data maximum is in the upwind direction and U has a 45 degrees phase shift in azimuth - as predicted by theory. There is also an up/downwind asymmetry of 2 degrees Kelvin in the Q data, and 1 degree Kelvin in the U data. The data collected at 50 degrees incidence angle show very similar wind direction signatures to the SSM/I model function. Additional flights were made cm other days under cloudy conditions. Data taken at a wind speed of 8 m/s show that at 40 degrees incidence Q and U have a smaller azimuthal modulation of 3 degrees Kelvin, probably due to the lower wind speed. Additionally, the simultaneously recorded video images of sea surfaces suggest that Q and U data were less sensitive to clouds, breaking waves and whitecaps, while the T_v and T_h increased by a few degrees Kelvin when the radiometer beam crossed over clouds, or there was a sudden increase of whitecaps in the radiometer footprint. The results of our aircraft flights clearly indicate that passive polarimetric radiometry is a viable option in space remote sensing of ocean surface wind direction as well as wind speed.